MINOS Near Detector
Front End Electronics

MINDER Module Functionality

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I. Trigger Sources

- Spill Gate Trigger
  - **SGATE** Comes from Clock System via MTM
  - Every MINDER has a Point-to-Point Connection with MTM

- Dynode Trigger
  - Comes from ASDLite Discriminators on KEEPER
  - Discriminated Signal from All PMTs Sent Onto Backplane as **nDTRIG[3:0]**
  - MINDERS Receive All 4 Signals
  - Slot Switch Settings on MINDER Tell It Which **nDTRIG** Signal to Respond To

- VME Trigger
  - Generated by Writing to a Register on the KEEPER (Which is a Location in Address Space on the MASTER)
  - KEEPER Generates **nDTRIG6**, Which is Sent onto MINDER Backplane
  - Use For:
    - ♦ Pedestals
    - ♦ DC Current Injection
    - ♦ Generating a Diagnostic Event

I. Trigger Sources (Cont.)

- **TCAL** Trigger
  - **TCAL** Comes from Clock System via MTM
  - Enables on MINDER Allow it to Respond to **TCAL** and Generate an Event

- **TCAL** Flasher Trigger
  - **TCAL** Comes from Clock System via MTM
  - Enables on MINDER Allow it to Form a Gate From **TCAL**
  - If Dynode Trigger Received Inside Gate, Event is Marked as a Flasher Event

- External Flasher Trigger
  - External Input on Keeper Can receive Trigger Signal from Flasher System
  - KEEPER Buffers and Sends onto MINDER Backplane as **nDTRIG4**
  - Received by All MINDERs on the Crate
  - Enables on MINDER Allow it to Form a Gate From **nDTRIG4**
  - If Dynode Trigger Received Inside Gate, Event is Marked as a Flasher Event

I. Trigger Sources (Cont.)

- External Process Trigger
  - External Input on Keeper Can receive Trigger Signal from an External Process
  - KEEPER Buffers and Sends onto MINDER Backplane as **nDTRIG5**
  - Received by All MINDERs on the Crate
  - Enables on MINDER Allow it to Respond

II. Summary of Trigger Signals

Trigger	Meaning	Used For
SGATE	Spill Gate	Trigger on Spill
nDTRIG0	Dynode Trigger PMT0	Cosmics, Flasher, PMT Noise
nDTRIG1	Dynode Trigger PMT1	Cosmics, Flasher, PMT Noise
nDTRIG2	Dynode Trigger PMT2	Cosmics, Flasher, PMT Noise
nDTRIG3	Dynode Trigger PMT3	Cosmics, Flasher, PMT Noise
nDTRIG4	Flasher Trigger Ext. Source	Forms Gate for Dynode Trigger
nDTRIG5	Ext. Process Trigger	Triggering from Ext. Process
nDTRIG6	VME Trigger	Pedestals, DC I Inj, Diagnostic Data
TCAL	Periodic Timing Signal	Diagnostics, Test Stands, Flasher

III. Mapping PMTs to Slots

- Address Switched on MINDER Correspond to Slot
- Switches Control Which of Dynode Signals (nDTRIG0 - nDTRIG3) to Respond To

Slot	nDTRIG
0- 2	None
3- 6	nDTRIG0
7-10	nDTRIG1
11-14	nDTRIG2
15-18	nDTRIG3
19-21	None

IV. Global Control Lines

- Set By Writing from MASTER to KEEPER
- Sourced By KEEPER Onto Backplane
- Received by All MINDERs

nCTRL	Meaning	Used For
nCTRL0	Mode Bit 0	Setting Mode
nCTRL1	Mode Bit 1	Setting Mode
nCTRL2	Mode Bit 2	Setting Mode
nCTRL3	SGATE Enable	Allow Response to SGATE - Norm Mode
nCTRL4	Dynode Trigger Enable	Allow Response to Dynode - Norm Mode
nCTRL5	Ext. Flash Trigger Enable	Allow Response to Ext Flash - Norm Mode
NCTRL6	TCAL Flash Enable	Allow Response to TCAL Flash Trig - Norm Mode
nCTRL7	Ext. Process Enable	Allow Response to Ext. Process Trig - Norm Mode

IV. Global Control Lines (Cont.)

- 3 Mode Bits → 8 States
- Only 1 State May Be Active at a Given Time

Mode		Meaning	Used For
000	0	OFF	Board Will Not Respond toTriggers
001	1	NORM Mode	Physics Uses nCTRL3-nCTRL7
010	2	PED Mode	Acquire Pedestals Uses VME Trigger
011	3	ICAL Mode	DC I Inj. Cal Uses VME Trigger
100	4	DIAG Mode	Diagnostic Event Uses VME Trigger
101	5	TCAL Trig 1	Trigger on TCAL DTRIG Sequence
110	6	TCAL Trig 2	Trigger on TCAL SGATE Sequence
111	7	QIE Reset	Generate QIE Reset Using TCAL

V. Data Types Defied

- 3 Data Type Bits → 8 Kinds
- Sent Along with Data

Data Type	Meaning	Set By
0	Pedestal	MODE[2:0] = 2 and nDTRIG6
1	ICAL	MODE [2:0] = 3 and nDTRIG6
2	Diagnostic	MODE [2:0] = 4 and nDTRIG6
3	TCAL (Not Flasher)	MODE [2:0] = 5 and nDTRIG6
4	Spill	MODE [2:0] = 1 and SGATE
5	Dynode	MODE [2:0] = 1 and nDTRIG***i***
6	Flasher	MODE [2:0] = 1 and nDTRIG***i***
7	Ext. Process	MODE [2:0] = 1 and nDTRIG5

VI. DAQ Priority Defined

- Problem:
  - Data Transmission from DTRIG Takes ~4.8 uSec = 256 RF Clock
  - Spill or Flash Can Come At Any Time
  - Need Method to Interrupt Lesser Important Processes

- 3 Levels of Priority, Used in NORM Mode Only

- Higher Priority Process Can Interrupt Lesser One

Priority	**Meaning**	**Can Interrupt:**
3	- Lowest Priority - Used for Dynode	- None - Ignored if Another Priority 1 in Progress
2	- 2nd Priority - Used Flasher & Ext. Proc.	- Priority 3 - Ignored if Another Priority 2 in Progress
1	- Highest Priority - Used for Spill	- Priority 2 & Priority 3 - Ignored if Another Priority 1 in Progress
N/A	- Pedestals, ICAL Diagnostic Mode, TCAL-Generated Event	- Does Not Interrupt - Cannot Be Interrupted - Ignores Triggers if in Progress

VII. DAQ Sequences

- 2 Kinds: DTRIG and SGATE
- Sequence Determined by Data Type

Sequence	Used For	# Time Slices
DTRIG	Cosimcs, Flasher, PMT Noise, Ext. Process, TCAL Trig 1	8
SGATE	Spill, Pedestals, ICAL, Diagnostic, TCAL Trig 2	~526 (?) (10 uSec)

VIII. Summary of Trigger Signal Processing

Trigger	Signal	nCTRL Value	Execution Delay	DAQ Sequence	Data Type	Priority
Spill	SGATE	1 (NORM) + 8 (SGATE) + (Other NORM)	No	SGATE	4	1
Dynode PMT0 (Cosmics, PMT Noise)	nDTRIG0	1 (NORM) + 16 (DYN En) + (Other NORM)	0-7 Clks DTRIG_DLY	DTRIG	5	3
Dynode PMT1 (Cosmics, PMT Noise)	nDTRIG1	1 (NORM) + 16 (DYN En) + (Other NORM)	0-7 Clks DTRIG_DLY	DTRIG	5	3

VIII. Summary of Trigger Signals (Cont.)

Trigger	Signal	nCTRL Value	Execution Delay	DAQ Sequence	Data Type	Priority
Dynode PMT2 (Cosmics, PMT Noise)	nDTRIG2	1 (NORM) + 16 (DYN En) + (Other NORM)	0-7 Clks DTRIG_DLY	DTRIG	5	3
Dynode PMT3 (Cosmics, PMT Noise)	nDTRIG3	1 (NORM) + 16 (DYN En) + (Other NORM)	0-7 Clks DTRIG_DLY	DTRIG	5	3

VIII. Summary of Trigger Signals (Cont.)

Trigger	Signal	nCTRL Value	Execution Delay	DAQ Sequence	Data Type	Priority
Pedestal (VME Trig)	nDTRIG6	2	No	SGATE	0	N/A
ICAL (VME Trig)	nDTRIG6	3	No	SGATE	1	N/A
Diagnostic (VME Trig)	nDTRIG6	4	No	SGATE	2	N/A
TCAL 1 (Short Event)	TCAL	5	No	DTRIG	3	N/A
TCAL 2 (Long Event)	TCAL	6	No	SGATE	3	N/A

VIII. Summary of Trigger Signals (Cont.)

Trigger	Signal	nCTRL Value	Execution Delay	DAQ Sequence	Data Type	Priority
Flash Event From TCAL (Gate DYN Trig)	TCAL	1 (NORM) + 16 (DYN En) + 64 (TCAL) + (Other NORM)	0-255 TFLSH_DLY 0-255 TFLSH_GATE	DTRIG	6	2
Flash Event From Flash Sys (Gate DYN Trig)	nDTRIG4	1 (NORM) + 16 (DYN En) + 32 (Ext Flash) + (Other NORM)	0-255 EFLSH_DLY 0-255 EFLSH_GATE	DTRIG	6	2
Ext. Process Event	nDTRIG5	1 (NORM) + 128 (PROCEN) + (Other NORM)	0-255 PROC_DLY	DTRIG	7	2
QIE Reset From TCAL	TCAL	7	No	N/A	N/A	N/A